ELECTRONIC DEVELOPMENT LABORATORIES INC.

The Temperature People

STS OPERATION MANUAL

SURFACE CALIBRATOR

STS Operation Manual

Notes:

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The Temperature People®
Since 1943

5/2007

Table of Contents

Chapter

1

Chapter 1

Introduction

The STS is a unique temperature calibrator for Surface calibrations, it is designed for daily use. This unit can help to improve your daily measurement capability without extensive knowledge of temperature metrology and laboratory based measurements. Throughout this manual, you will find not only instruction specific to the STS, but many other helpful tips and suggestions regarding temperature measurement and calibration.

Features and Capabilities

Contact surface calibration is an area of temperature measurement that is of significant concern to most industrial users, shown in figure 1. The STS contact surface calibrator allows the user to quickly make comparison readings. There is virtually no standard surface temperature measurement device that cannot be calibrated to a reasonable tolerance using the STS contact surface calibrator.

Contact Surface Calibration

Contact surface measurements are made using many different types of sensors; these types of sensors can be easily calibrated using the STS contact surface calibrator. Common types of these sensors include the following styles:

1. Coil spring
2. Band style
3. Mini-Wand
4. Solid disc

The STS contains approximately three and one eigth square inches of surface area suited for comparison calibrations. An imbedded sensor beneath this area provides an output for direct reading of the surface where the calibration is being done thus eliminating any concern for block gradients and non-uniformities.

Controller Features

The STS uses a high quality controller to accurately control and maintain its high accuracy. The advanced technology features a very stable temperature control with a calibrated PID loop. The two-line display allows you to see the set temperature along with the actual reading temperature at all times.

Output Connections

The Surface temperature output reference connection is provided on the back of the STS for making direct comparisons to the internal sensor, shown in figure 2.

By using a calibrated instrument and adaptor lead, the STS can be used as a temperature source only. This method will improve your absolute accuracy and lower the overall uncertainty of your measurement. Further explanation of the uncertainty analysis of this instrument is presented in Appendix 2.

General Construction

The STS has been designed with the industrial user in mind. All of the major components are constructed from Aluminum and Stainless Steel. The finish is a baked epoxy powder coating like the type used on automobile frames. The electrical components are commercially available items; no proprietary electronic devices have been used in this product. Our goal is to provide a product that functions well but can be maintained for many years to come without the fear of unavailability of parts. The STS is 100% designed and built at our facility in Danville VA.

Chapter

2

Chapter 2

Installation and Setup

Unpack and carefully inspect the unit for any damage that may have occurred in shipping. **Do Not Plug In the Unit Until It Has Been Inspected.** There should be no loose parts or any bent or damaged surfaces. Make sure there are no stray pieces of packing material anywhere in or on the calibrator. This is very important as this material could ignite during heat up.

Connecting to Power Source

The power required for this unit is 110VAC, 60Hz with a maximum current requirement of 10.0 Amperes. Plug the cord into the power input module on the back of the STS, figure 3, and then plug the other end into any 110VAC outlet capable of supplying the required current. The outlet must be grounded, thus reducing the hazard of electrical shock!

Basic Front Panel Operation

There is one switch and four soft keys on the front control panel. Full operation of the STS is accomplished through these keys. The switch, under the controller, controls the fast cool fan for increasing the rate of cool down.

Initial Start up

The initial preprogrammed set point is 100°C; the unit should be operated at this temperature for a period of one hour prior to using this unit. This procedure serves to remove any moisture that may have occurred as a result of condensation during shipment. The fast cool switch should be in the off position.

Soft Keys

All programming functions are performed using the two small keys with up and down arrows on the front of the controller. The unit is shipped preprogrammed and should be used without any changes other than setting the desired temperature. To set the desired temperature, use the up and down arrow keys until the bottom green display shows the desired temperature.

Fast Cool Switch

This switch should be in the off position during heat up and normal use, shown in figure 2. It is intended to accelerate the cool down rate so less time is required between changes in set point.

This is a low volume fan and will not cause a large amount of air to flow out of the calibrator. A low volume of air limits the flow of very hot air onto the operator and the sensor being calibrated. Associated rates for heat up and cool down are shown in Appendix 1.

Rear Panel Fuse

The rear panel fuse is the main power fuse and the On/Off switch and limits the current to the entire unit, shown in figures 1 &3. This is a 10 Amp fuse and should not be altered for any reason. Fuse Ratings are shown in Appendix 1.

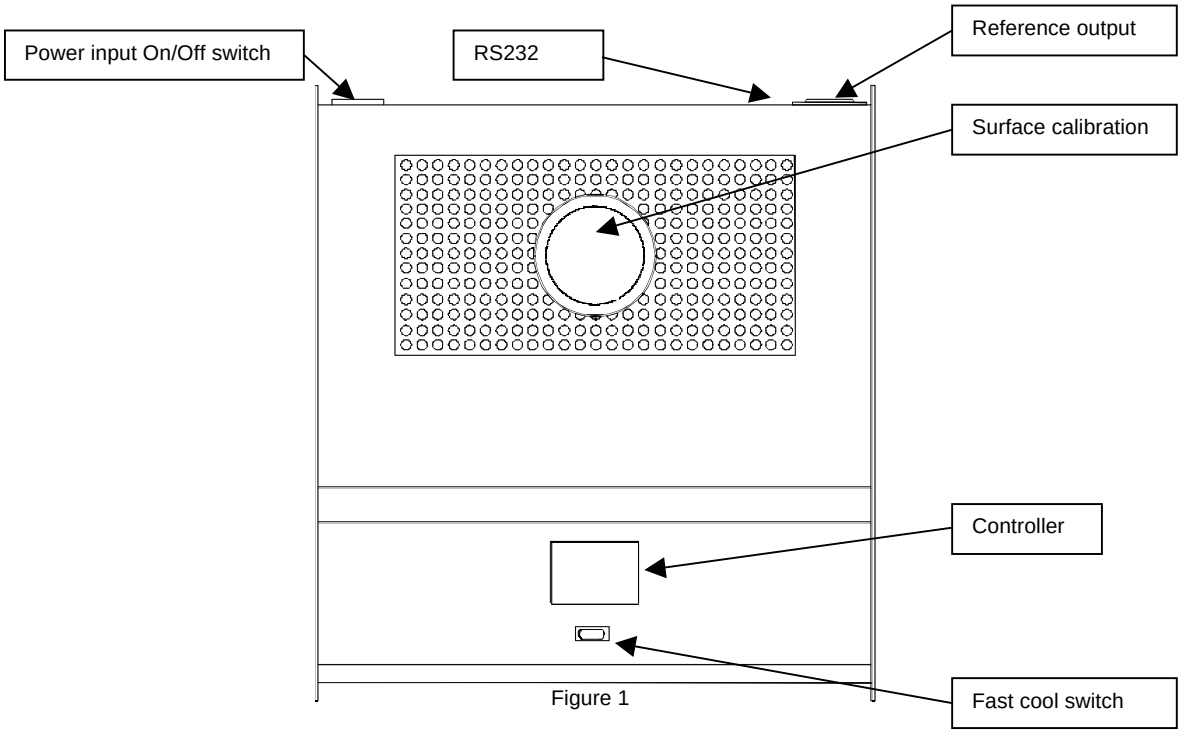

Figure 1

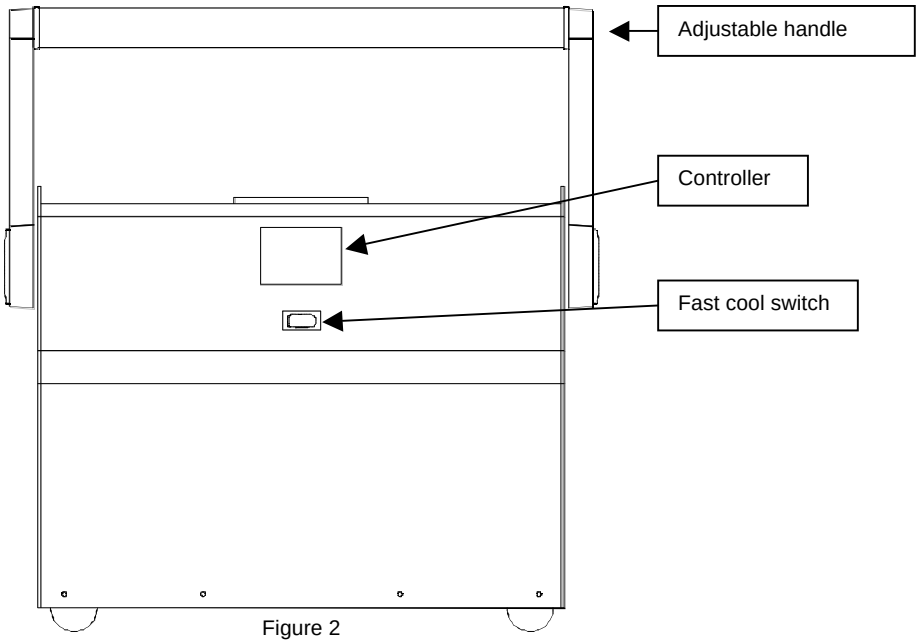

Figure 2

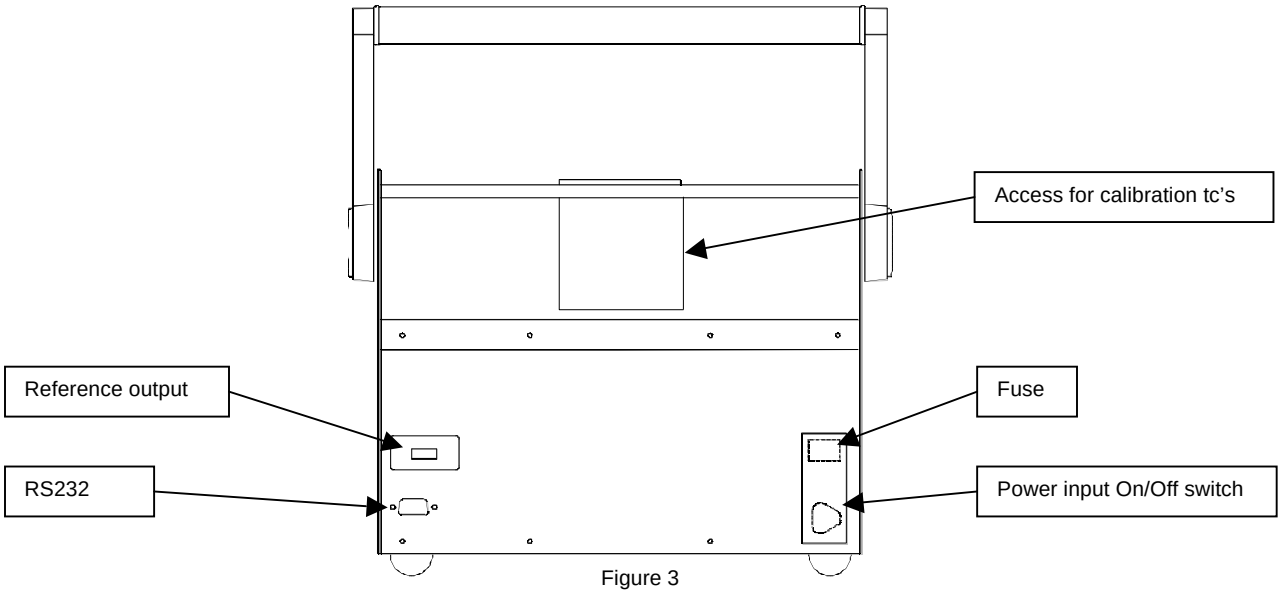

Figure 3

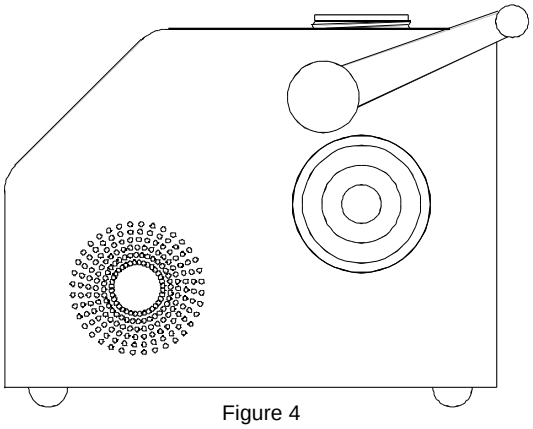

Figure 4

Chapter

3

Chapter 3

Use and Operation

The first step in using the STS is to determine your temperature set point requirement. You may set the STS to any temperature between ambient plus 5ºC (10°F) and 650ºC (1 202°F) with a resolution of 0.1°C & 0.1°F. To set the desired temperature see page 4, "Soft Keys." Once the temperature is set, sufficient time should be allowed for the block to reach its set point temperature and stabilize. Stabilization for most temperature ranges is achieved within 25 minutes after reaching the set point. If you are working close to ambient, you may need to keep the fast cool fan on. For additional information regarding heat up rates and stabilization times see Appendix 1.

Contact Surface Comparisons

Although many industries employ some type of surface temperature measurement device on a daily basis, surface comparison calibrations are generally misunderstood and probably one of the least evolved areas of temperature calibration. The STS is an excellent device for making reasonably accurate surface calibrations. A comparison calibration can be made by placing the surface sensor directly onto the top of the brass block, holding it flat and steady. The UUT reading would then be directly compared to the PV display line on the controller. A greatly improved accuracy with a significantly lower uncertainty will be achieved by connecting a calibrated pyrometer to the reference TC output on back of the STS. There is an embedded thermocouple directly below the surface area on the top of the brass block. The output of this sensor is connected directly to reference TC output. Please see Appendix 1 & 2 for a detailed assessment of the specific accuracies and uncertainties. See figure 5 for typical setup.

Contact Surface Technique

A good measurement requires some skill and technique; adhering to the following list of good practices will develop this technique.

1. Always use the area of the block designated for surface readings.
2. Use constant even pressure on the sensor.
3. Keep the sensor square, at a right angle, to the calibrator's surface.
4. Allow sufficient time for the sensor to reach temperature.

5. Use the same time base for similar type sensors.

6. It is recommended that an external reference be used for surface calibrations.

7. Keep the surface clean and free from oxidation by cleaning as required with 600-grit emery cloth.

8. Always sand the surface with the power off and the block at room temperature.

9. If the surface becomes badly dented, resurfacing may be required.

10. Never twist, drag, or slide a sensor on the surface.

11. Do not use solvents or liquid cleaners on the surface

Note: Reference temperature is read prior to applying sensor to surface.
UUT temperature is read after UUT sensor is applied to STS and Stable

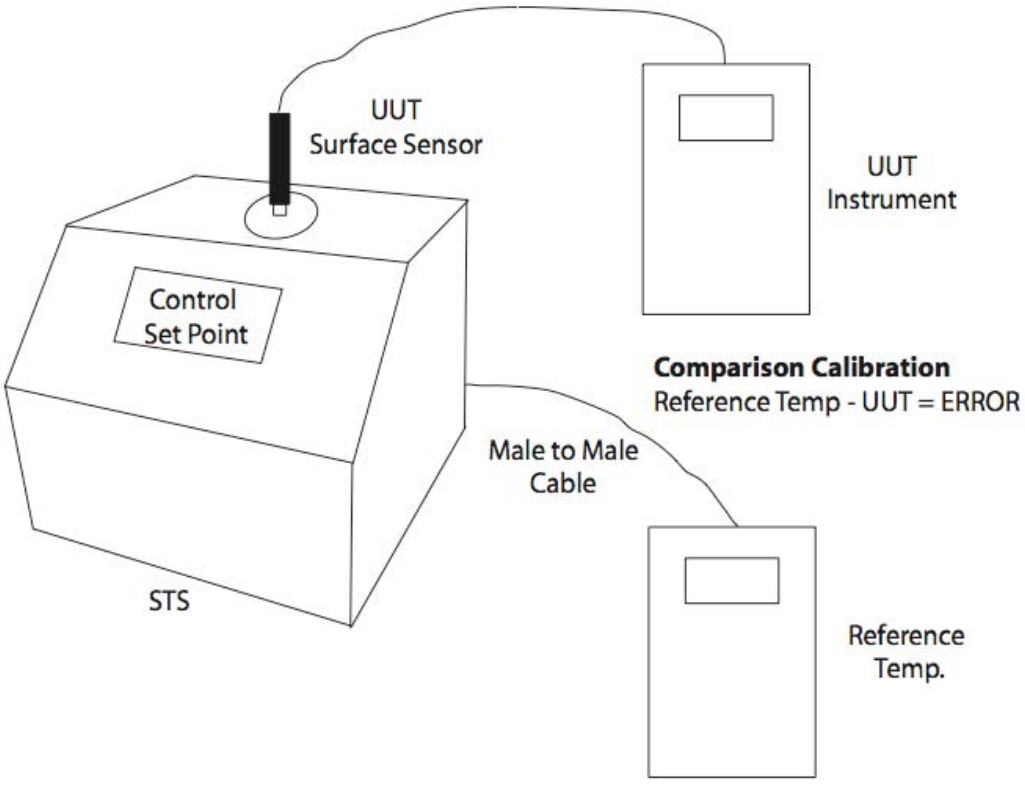

Figure 5

Chapter

4

Chapter 4

Improving Your Measurements

This chapter contains fundamental information that will help you to improve your temperature measurements. There are rarely any easy temperature measurements and close attention to the details provided in the following sections will help to improve your measurements.

Contact Surface Measurements

Surface calibrations are frequently used in industry; EDL has been manufacturing numerous types of surface sensors for over fifty years, and this experience has led to the simple but extremely effective method of calibration used with the STS. The following list further explains the necessary components required to make reliable contact surface measurements.

1. A reference sensor will provide a base line for your measurements. There are some unavoidable variables in all types of temperature measurement including surface measurements. When the STS is received, a baseline test using a standard reference surface sensor is recommended. Simply make a comparison between this reference sensor and the reference TC output. Using this technique as a cross check will help to identify issues such as block surface wear.

2. Timing is critical for surface measurements because the surface is constantly in a dynamic state. The surface being measured is influenced by the UUT and its physical parameters along with the environment. To achieve good readings, all of the items in Chapter 3 must be followed. In addition, the sensor and the embedded surface reference should be allowed to reach a steady state condition. Typically, this condition should be reached in about 30 seconds. You should set some time limit for the test; this will help to normalize your data.

3. A calibrated reference instrument is strongly recommended for surface measurements. This is accomplished by utilizing the reference TC output on the rear panel with a calibrated reference pyrometer. This moves your reference comparison directly to the surface instead of relying on the controller input, which uses a sensor lower in the block and very far from the surface. If your expected tolerance is large, you can use the PV display on the controller as the reference reading but you must apply the appropriate uncertainty as shown in Appendix 2.

Note: *The comparison must be made between the block temperature, prior to applying the sensor to the surface of the block, and the UUT reading after reaching steady state.*

Application Note 1

Helpful Hints on Using the SS Series Style Sensors

March 1, 2005

Do

- Apply the sensor with constant perpendicular force.
- Use the proper sensor for the application, standard ceramics up to 1000°F and Cordierite for temperatures over 1000°F.
- Use the sensor on flat clean surfaces.
- Preheat the sensor to a temperature near the measurement point.
- Gently clean the coils by rinsing with alcohol or other solvent depending on use.
- Consider the use of calibration and validation techniques to ensure the sensor is performing properly
- Maintain one instrument and sensor as a reference standard.
- Have your surface sensors calibrated, (Factory Calibration is Recommended)

Do Not

- Do not rock or rotate the sensor.
- Do not slide or move the sensor once it is applied to the surface.
- Do not bring the sensor in contact with adhesives or wet paints, any material that will adhere to the coils.
- Do not attempt to adjust the coils; we use special tools and jigs to "set" the coils.
- Do not attempt to calibrate an "SS" sensor without the proper equipment. We recommend the use of EDL calibration equipment as it is designed specifically for use with our sensors.
- Do not use ceramic tip sensors on polished mold surfaces; use our specially designed Teflon® tipped "SS" sensor.

Engineering Specifics

The s-spring coil design creates a constant force over a wide temperature range reducing the variability in reading due to variability in conduction rate. The force does change slightly at elevated temperature but other modes of heat transfer increase compensating for the very slight loss in conduction. 'SS' sensors will work best on flat hard surfaces but they will also work well on softer surfaces that tend to envelop the coil, those materials such as foam or rubber. They can also be used on flat intermediate hardness materials such as plastic. When making measurements on curved surfaces remember to align the wire between the coils in parallel with the pipe, and only attempt this on diameters greater than one inch. Preheating the sensor will reduce the amount of heat conducted from the surface thus reducing the perverting effect of a contacting sensor providing faster and more accurate readings. Calibration of these sensors is best accomplished with EDL calibration equipment or by sending the sensors to the EDL calibration laboratory. Further information regarding the calibration of surface sensors can be found at the either of the following links.

http://www.edl-inc.com/Presentations/sts%20pres_files/frame.htm
http://www.x-cd.com/ncsl03/prof90.html

Chapter

5

Chapter 5

Trouble Shooting

The STS is a precision surface calibrator designed for daily use in harsh environments. For better serviceability, we have chosen standard components based on past performance and commercial availability. This manual describes the use of the product, but also includes all specifications, programming information, complete parts lists, and a detailed electrical diagram. In addition, the factory provides complete support for this product. Technician level personnel are available to assist in trouble shooting the device; laboratory and engineering personnel are available to assist you with issues regarding calibration.

Appendix 1

STS Specifications

Physical

- Dimensions ..... 300mm (12") deep x 250mm (10") wide x 350mm (14") tall
- Weight ..... 27 lbs
- Surface ..... Epoxy Powder Coat
- Material ..... Aluminum, Stainless Steel, Brass
- Usage Surface Area ..... ~ 3.14 IN^2

Electrical

- Power ..... 110 VAC, 7.5 Amp 60HZ
- Heaters ..... 110 VAC 800 Watts
- Main Fuse ..... 250VAC-10 Amp
- Power Relay ..... 250VAC-25 Amp (overrated for extended service)

Accuracy Specifications

- Range ..... STS-SC1 Ambient to 650°C (Ambient to 1 202°F)
  ..... STS-SC2 Ambient to 315°C (Ambient to 600°F)
- Resolution ..... 0.1°C
- Stability ..... +/- 0.5°C (over 15 min. period)
- Uniformity ..... +/- 1.0°C

(Note: Absolute accuracy may be improved by using remote reference.)

Heat up / Cool down Rates

- Heat-up ..... Approx. 15°C/min. (from 100°C to 300°C)

- Cool down ..... 2.0°C/min (300°C to 100°C)

Appendix 2

Uncertainties

The uncertainties associated with the testing of this unit follow the NIST Guidelines for Evaluating and Expressing Uncertainty (Technical Note 1297). Type A uncertainties are combined with Type B uncertainties, where Type A is statistical data representing the measurements and Type B is based on scientific judgment of all relevant information concerning the testing. It is also assumed that uniform distribution exists for the measurement data. The two types of data are combined using the root sum squares method (RSS).

The expanded uncertainty for the testing of this instrument is 1.9 °C k=2

Appendix 3

Parts List

Options:	**Option Code:**	**Price:**
220VAC Power	2	$275.00

Calibration of Device $250.00

Standard Replacement Parts:	**Part #**	**Price:**
Controller	EEC-CNTRLR32162	$493.50
Solid State Relay Crydom 25 Amp	ECR-SLDSTTRELAY	$43.16
DPDT Rocker Switch	SWR-RKRDPDT	$3.15
Power cord 110 VAC 10 Amp	EHP-PWRCRD10	$5.27
Fuses 10 Amp (5 pack)	EHU-FS10A5X20-5	$6.55 (5 pack)

Index